A Seeming Paradox—

Soil Condition Best After Grazing

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Question: Which is best for rangeland soils? No livestock grazing? Light or heavy grazing?

Answer: Grazing, whether light or heavy, results in better soil—as measured by its organic carbon and nitrogen content—compared to ungrazed rangeland.

Confused? So are a lot of people when it comes to understanding and finding ways to improve or sustain the condition of more than 300 million acres of short- and mixed-grass rangeland in the West.

A couple of studies by Agricultural Research Service scientists at the High Plains Grasslands Research Station near Cheyenne, Wyoming, are beginning to shed some light on this confusion.

"Both heavy and light grazing increased the amount of soil organic carbon and nitrogen present in the top 12 inches of rangeland topsoil," says ARS soil scientist Gerald Schuman.

"That's significant, because soil carbon and nitrogen are important sources of energy and nutrients for the soil microorganisms responsible for nutrient cycling, and because 70 to 90 percent of a grassland's roots are in that soil horizon." And deeper measurements for these soil constituents—down to 36 inches—showed no consistent differences due to grazing.

It should be noted, says Schuman, that heavy grazing removed only about half of the grass produced during a season and was not harmful to the plant community. Nor did it significantly alter the plant species mix.

Under heavy grazing, rangeland was stocked at 27 animal-days per acre, or just over 6 acres per cow for a 165-day grazing season. The light-grazed rangeland was stocked at 9 animal-days per acre, and both grazed areas had been grazed at the same stocking rates for 11 years. The ungrazed areas on the station have been fenced to exclude cattle and large wildlife for the past 40 years.

Why isn't excluding cattle from fragile rangelands the best way to preserve these natural resources?

"First of all, these lands are far from fragile, if managed properly," says Richard H. Hart, ARS rangeland scientist at the station. "After all, the plants on these rangelands evolved to withstand grazing by bison and other large ruminants. They are pretty resilient and can quickly recover from even our heavy grazing rate. But, cautions Hart, range managers must carefully monitor grazing intensity and adjust when needed, to avoid damage to the rangeland.

"Ungrazed rangeland has more carbon and nitrogen tied up in the dead plant material accumulated above ground. And, this material can break down and blow away without contributing much carbon and nitrogen to the soil," says Schuman.

But when cattle graze rangeland, their several-hundred-pound bodies trample the plant material into small pieces and aid in its decomposition and incorporation into the soil surface. And cattle excrete large amounts of manure, rich in plant nutrients. Both activities help to recycle carbon and nitrogen into the soil.

In another study aimed at helping answer questions related to the role of grazing in maintaining rangeland health, Jack A. Morgan is measuring photosynthesis on these same pastures. He is an ARS plant physiologist with the Cheyenne unit who is stationed in Fort Collins, Colorado.

In the first year of his study, Morgan found that plants on the grazed areas had higher springtime photosynthesis rates than those in the ungrazed areas. A partial explanation for this difference was that there wasn't a lot of dead standing material blocking the sunlight. There was also more live leaf area on the grazed pastures in early spring.

This early-season photosynthetic advantage under grazing may increase the total amount of carbon taken up by the rangeland plants. Some of this increase will be incorporated into the soil through greater plant growth, livestock trampling, and excretion.—By **Dennis Senft,** ARS.

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